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Testimony

Statement of
Eric J. Labs
Senior Analyst for Naval Forces and Weapons

The Long-Term Outlook for the U.S. Navy's Fleet

before the
Subcommittee on Seapower and Expeditionary Forces
Committee on Armed Services
U.S. House of Representatives

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Mr. Chairman, Congressman Akin, and Members of the Subcommittee, I appreciate the opportunity to appear before you today to discuss the challenges that the Navy is facing in its plans for building its future fleet. Specifically, the Subcommittee asked the Congressional Budget Office (CBO) to examine three matters: the Navy's draft shipbuilding plan for fiscal year 2011, the effect that replacing Ohio class submarines with a new class of submarines will have on the Navy's shipbuilding program, and the number of ships that may be needed to support ballistic missile defense from the sea. CBO's analysis of those issues indicates the following:

- If the Navy receives the same amount of money for ship construction in the next 30 years that it has over the past three decades—an average of about $15 billion per year in 2009 dollars—it will not be able to execute its fiscal year 2009 plan to increase the fleet from 287 battle force ships to 313.[1] As a result, the draft 2011 shipbuilding plan drastically reduces the number of ships the Navy would purchase over 30 years, leading to a much smaller fleet than either the one in the 2009 plan or today's fleet.

- The draft 2011 shipbuilding plan increases the Navy's stated requirement for its fleet from 313 ships to 324, but the production schedule in the plan would buy only 222 ships, too few to meet the requirement. The Navy's current 287-ship fleet consists of 239 combat ships and 48 logistics and support ships. The 2009 plan envisioned expanding the fleet to a total of 322 ships by 2038: 268 combat ships and 54 logistics and support ships. In contrast, under the draft 2011 plan, the fleet would decline to a total of 237 ships by 2040: 185 combat ships and 52 logistics and support ships.[2]

- CBO's preliminary estimate is that implementing the draft 2011 shipbuilding plan would cost an average of about $20 billion per year for all activities related to ship construction (including modernizing some current surface combatants and refueling ships' nuclear reactors). A more detailed estimate will follow after the Navy formally submits its final 2011 plan to the Congress in February with the President's budget request.

- Replacing the 14 ballistic missile submarines (SSBNs) of the Ohio class—which are due to start reaching the end of their service lives in the late 2020s—with 12 new SSBNs could cost about $85 billion. If the Navy received that amount in addition to the resources needed to carry out the draft 2011 plan (which includes funding for those new submarines), it could probably purchase the additional ships identified in the "alternative construction plan" that accompanied the draft 2011

1. "Battle force" is the term the Navy uses to describe its fleet, which includes all combat ships (surface combatants, aircraft carriers, submarines, and amphibious ships) as well as many types of logistics and support ships.

2. The Navy's long-term shipbuilding plans typically cover 30 years, so 2038 is the last year of the 2009 plan, and 2040 is the final year of the draft 2011 plan.

plan, because CBO's preliminary estimate of the cost of that alternative plan is an average of about $23 billion per year over 30 years.

- Sea-based ballistic missile defense, a relatively new mission for the Navy, could require a substantial commitment of resources. That commitment could make it difficult for the Navy to fund other ship programs.

Before discussing those issues, however, let me briefly recap CBO's analysis of the 2009 shipbuilding plan as a point of departure for examining the draft 2011 plan.

The Navy's 2009 Shipbuilding Plan and the Effects of Extending Current Funding Levels

For much of the past decade, the Navy spent an average of about $13 billion a year (in 2009 dollars) on shipbuilding: approximately $11 billion to construct new ships and $2 billion to refuel nuclear-powered aircraft carriers and submarines and to modernize surface combatants. In a report to this Subcommittee, CBO estimated that carrying out the Navy's 2009 plan to build and sustain a 313-ship fleet would cost far more than that: a total of about $800 billion (in 2009 dollars) over 30 years—or an average of almost $27 billion a year (see Table 1).[3] Those costs would include the purchase of 296 new ships, nuclear refuelings of aircraft carriers and submarines, and the purchase of mission modules for littoral combat ships (LCSs). New-ship construction alone would cost about $25 billion a year, including new ballistic missile submarines.

The Navy's cost estimate for implementing the 2009 plan was only slightly lower than CBO's projection. The Navy estimated that it would need to spend a total of about $750 billion over the 30-year period of the 2009 plan—or an average of about $25 billion per year for all shipbuilding activities and about $23 billion per year for new-ship construction alone. In contrast to the similarity between CBO's and the Navy's estimates for the 2009 plan, CBO's estimates for the 2007 and 2008 shipbuilding plans were approximately 30 percent to 35 percent higher than the Navy's estimates (which were substantially smaller than the service's estimate for its 2009 plan).[4]

Historical Funding for Ships

Over the past 30 years, the distribution of the Navy's shipbuilding budget among the major categories of ships has been fairly stable. Surface combatants have received about 37 percent of shipbuilding funds; submarines, 30 percent; aircraft carriers, 16 percent; amphibious ships, 10 percent; and logistics and support ships, 7 percent. The 2009 shipbuilding plan envisioned increasing the share of funding devoted to submarine construction from 30 percent to an average of 38 percent over the next 30 years, CBO estimated—largely at the expense of logistics and support ships and

3. For more details, see Congressional Budget Office, *Resource Implications of the Navy's Fiscal Year 2009 Shipbuilding Plan,* attachment to a letter to the Honorable Gene Taylor (June 9, 2008).

4. Ibid., pp. 10–13. The Navy did not release a shipbuilding plan for fiscal year 2010.

Table 1.

Funding for Major Categories of Ships in the Past and Under the Navy's 2009 Plan

	Actual, 1980 to 2009	Navy's 2009 Shipbuilding Plan, 2009 to 2038
	Average Annual Funding (Billions of 2009 dollars)	
Surface Combatants	5.3	9.6
Submarines	4.3	10.0
Aircraft Carriers	2.3	3.7
Amphibious Ships	1.4	2.6
Logistics and Support Ships	1.1	1.1
Total	**14.4**	**26.9** [a]
	Percentage of Total Shipbuilding Budget	
Surface Combatants	37	34
Submarines	30	38
Aircraft Carriers	16	14
Amphibious Ships	10	10
Logistics and Support Ships	7	4
Total	**100**	**100**

Source: Congressional Budget Office.

a. Includes funding to modernize some existing surface combatants, refuel nuclear reactors on aircraft carriers and submarines, and produce mission modules for littoral combat ships.

surface combatants (see Table 1). That projected increase resulted mainly from including the costs of replacing the Navy's SSBNs (which are discussed in more detail later in this testimony). Table 1 illustrates some of the challenges the Navy faces in funding its ship accounts. Average annual spending for surface combatants would have to rise by 80 percent—and spending for submarine construction would need to more than double—for the Navy to buy the major combat ships included in the 2009 plan.

One factor that contributes to the Navy's funding challenges is the historical trend of rising average costs per ship (see Table 2). During the 1980s, the era of the Reagan Administration's military buildup, the Navy paid an average of about $1.2 billion (in 2009 dollars) for a new ship. The new ships in the 2009 plan would cost an average of about $2.5 billion apiece by the Navy's estimate, or $2.7 billion apiece by CBO's estimate. The most recent information on actual ship purchases comes from the 2010 defense appropriation act, which allocates nearly $15 billion to buy seven ships, for an average cost of about $2.1 billion each. That figure is smaller than the estimates of per-ship costs under the 2009 plan because five of the seven ships purchased in the 2010 appropriation act (two LCSs, two T-AKE logistics ships, and one high-speed

Table 2.

Average Ship Costs and Purchases in the Past and Under the Navy's 2009 Plan

	Average Cost per Ship (Billions of 2009 dollars)	Average Number of Ships Purchased per Year
1980s	1.2	17.2
1990s	1.5	7.4
2000s	2.0	6.0
2009 Shipbuilding Plan		
Navy's estimate	2.5	9.9
CBO's estimate	2.7	9.9
Memorandum:		
Steady-State Requirement for a 313-Ship Fleet[a]	n.a.	8.9

Source: Congressional Budget Office.

Note: n.a. = not applicable.

a. Steady state refers to a situation in which the total number of ships remains constant from one year to the next as new ships replace ones that are retired from the fleet.

vessel) are relatively inexpensive, costing no more than about $600 million apiece. The 2010 shipbuilding appropriation illustrates how a fleet composed of less expensive ships could stop the trend of growing average costs per ship, although it could result in a less capable fleet than the more expensive ships in the Navy's 2009 plan.

The rise in average ship costs over time may stem from several factors:

- When the Navy buys a new generation of ships, it improves their capabilities, thus driving up their costs.[5] For example, the Arleigh Burke class destroyer, which was first built in the 1980s, is much more capable—and much more expensive—than the preceding Spruance class destroyer, which was built mainly in the 1970s. Likewise, future versions of the Arleigh Burke class destroyer configured to perform ballistic missile defense are likely to be more costly than existing ships.

- Over the past two decades, increases in labor and materials costs to build naval ships in the United States have outstripped inflation in the economy as a whole.

5. A report by the RAND Corporation supports this idea. It concluded that half of the increase in the cost of Navy ships from the 1960s to the mid-2000s was attributable to inflation in the economy as a whole, and the other half resulted from the Navy's purchase of increasingly capable ships. See Mark V. Arena and others, *Why Has the Cost of Navy Ships Risen? A Macroscopic Examination of the Trends in U.S. Naval Ship Costs Over the Past Several Decades,* MG-484-NAVY (Santa Monica, Calif.: RAND Corporation, 2006).

Specifically, the cost of building ships has been rising about 1.4 percent faster per year than the prices of final goods and services in the U.S. economy (as measured by the gross domestic product deflator).

- As average ship costs have increased, the Navy has bought fewer ships. However, the fixed overhead costs at naval shipyards may not have declined at the same rate. Thus, with fewer ships being purchased, the average amount of fixed overhead costs per ship may have risen.

The numbers in Table 2 illustrate the decline in ship purchases over time. During the 1980s, the Navy bought an average of 17.2 ships per year in pursuit of a 600-ship fleet. By the 2000s, that number had fallen to 6.0 ships a year. To sustain the steady-state fleet of 313 ships envisioned in the 2009 plan, however, the Navy would need to buy 8.9 ships per year, under an assumption that the ships had an average service life of 35 years.[6] (A larger fleet of 324 ships, the reported goal of the draft 2011 plan, would require buying 9.3 ships per year over the long term.) To compensate for earlier years in which the Navy bought fewer than 8.9 ships per year, the 2009 shipbuilding plan would purchase 9.9 ships each year to achieve and maintain a 313-ship fleet.

The Effects of Current Budget Levels on the Future Fleet

Despite the large funding increases that would be necessary to carry out the 2009 plan, senior Navy officials have said in recent months that the service expects to make do with $13 billion to $15 billion per year for its future shipbuilding. In October 2009, the Deputy Assistant Secretary of the Navy for Ship Programs, Allison Stiller, said she thought "$13 billion [per year] is about right."[7] Several weeks later, however, the Under Secretary of the Navy, Robert O. Work, stated, "We think we can do what we need on $15 billion a year."[8] Those funding levels—which represent about 50 percent to 60 percent of the amount required to fund the 2009 shipbuilding plan—are similar to what the Congress has appropriated in recent years. In both 2008 and 2009, the Navy received about $14 billion for ship construction, in each case more than the Administration had requested. For 2010, the President's budget requested $14.9 billion for ship construction, and the Congress appropriated $15.0 billion.

CBO compared the number of ships that could be purchased with annual budgets of either $13 billion ($390 billion over 30 years) or $15 billion ($450 billion over

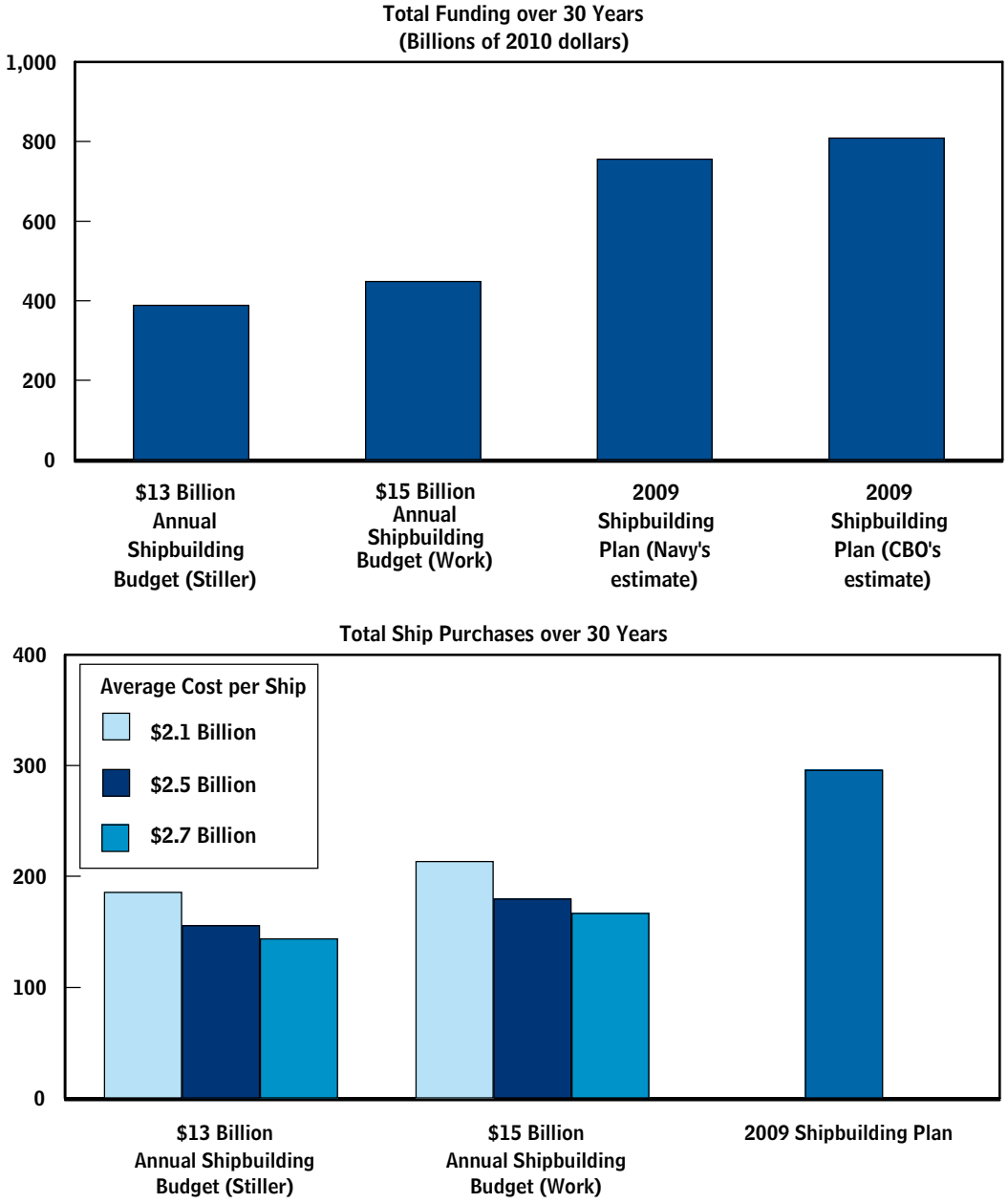
6. Steady state refers to a situation in which the inventory of ships theoretically remains constant from one year to the next as new ships replace ones that are retired from the fleet. The average number of ships that would have to be purchased each year to keep the fleet at a given size indefinitely equals that steady-state force size divided by the stated service life of a ship. Thus, a 313-ship fleet divided by an average service life of 35 yields a requirement to buy 8.9 ships a year.

7. Zachery M. Peterson, "Stiller: $13 Billion for Shipbuilding Per Year 'About Right' for Now," *Inside the Navy* (October 19, 2009).

8. Dan Taylor, "Work: Navy Will Try to Keep Shipbuilding Budget at $15 Billion," *Inside the Navy* (November 2, 2009).

Figure 1.

Total Funding and Ship Purchases Under Various Scenarios



Source: Congressional Budget Office.

Note: "Stiller" refers to the Deputy Assistant Secretary of the Navy for Ship Programs, Allison Stiller, and "Work" refers to the Under Secretary of the Navy, Robert O. Work.

30 years) under three scenarios for average ship costs: $2.1 billion per ship, as in the 2010 defense appropriation; $2.5 billion per ship, as in the Navy's estimate for the 2009 plan; and $2.7 billion per ship, as in CBO's estimate for the 2009 plan.[9] That plan envisioned buying a total of 296 ships over 30 years. Under the constrained budgets, roughly one-half to three-quarters of that number of ships could be purchased, depending on the average cost per ship (see Figure 1). At the bottom end of the range, a $13 billion annual budget would buy 144 ships over 30 years at an average cost of $2.7 billion apiece. At the top end of the range, a $15 billion annual budget would yield 214 new ships over 30 years if their cost averaged $2.1 billion.

The ship purchases under those scenarios would not be large enough to replace all of the Navy's current ships as they reach the end of their service lives in coming years. Consequently, with those annual budget levels and average ship costs, the size of the Navy's fleet would decline over the next three decades from 287 ships to between 170 and 240 ships. Specifically, if Navy ships cost an average of $2.1 billion apiece, the battle force fleet would fall to about 270 ships by 2025 with a $15 billion annual budget or to 250 ships with a $13 billion budget (see Figure 2). However, if the cost per ship averaged $2.7 billion, the fleet would decline to about 230 ships by 2025 under the lower budget level or to about 240 ships under the higher level. By 2038, the last year of the 2009 shipbuilding plan, the effect on the fleet would be more pronounced. The high end of the range (a $15 billion shipbuilding budget and an average cost of $2.1 billion per ship) would be 240 ships, but the low end (a $13 billion budget and $2.7 billion per ship) would yield just 170 ships—60 percent of the size of today's fleet.

The Navy's Draft 2011 Shipbuilding Plan

The Subcommittee asked CBO to analyze the procurement and inventory tables from a draft of the Navy's shipbuilding plan for fiscal year 2011. The six tables, which have not been officially released, were published at InsideDefense.com.[10]

- One table shows an increase in the target size of the battle force fleet from 313 ships to 324. The target for large surface combatants (cruisers and destroyers) has been raised from 88 to 96, and the desired number of support ships has nearly doubled from 20 to 39. Those increases are partly offset by deleting the requirements for future maritime prepositioning ships and guided missile submarines.

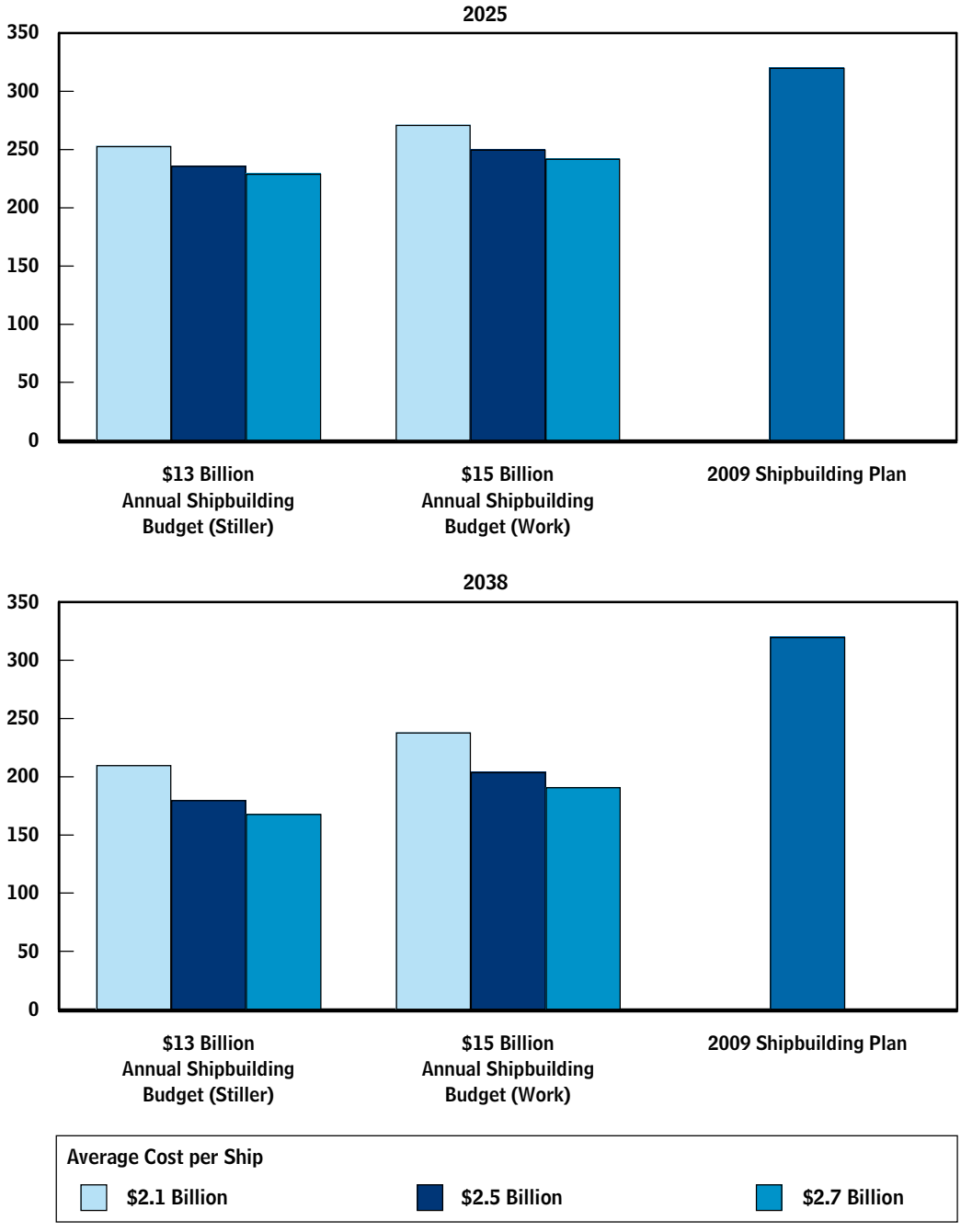
9. For its estimate, CBO divided the total amount of money that it projected would be necessary for all shipbuilding activities in the 2009 plan—new construction, refuelings of nuclear-powered aircraft carriers and submarines, and other (minor) expenditures—by the number of ships purchased under the plan to determine the average cost per ship. That calculation was made to allow comparisons with the notional budget levels of $13 billion and $15 billion, which CBO assumed would also include all shipbuilding activities. If the calculation used funding for new-ship construction alone, the average cost per ship under the 2009 plan would be slightly lower. See Congressional Budget Office, *Resource Implications of the Navy's Fiscal Year 2009 Shipbuilding Plan,* p. 2.

10. See www.insidedefense.com/secure/data_extra/pdf8/dplus2009_3796.pdf.

Figure 2.

Projected Inventory of Navy Ships Under Various Scenarios

(Number of ships)



Source: Congressional Budget Office.

Note: "Stiller" refers to the Deputy Assistant Secretary of the Navy for Ship Programs, Allison Stiller, and "Work" refers to the Under Secretary of the Navy, Robert O. Work.

- Other tables show more details of the draft 2011 plan: construction and funding profiles for Navy ships from 2011 to 2015 and the construction profile and inventory of battle force ships from 2011 to 2040. Those profiles indicate that the Navy envisions buying 222 ships (including 12 SSBNs) in the next 30 years under the draft 2011 plan, compared with 296 ships under the 2009 plan.[11] With those purchases, the size of the battle force fleet would peak at 312 ships in 2021 and then decline steadily to 237 ships by 2040. (In comparison, the 2009 shipbuilding plan envisioned a fleet of 322 ships in 2038, the last year of its projection period.)

- The remaining tables show the construction profile and inventory of battle force ships through 2040 under an "alternative construction plan." That plan assumes that the Navy receives funding to purchase a new class of SSBNs in addition to the full funding needed for the draft 2011 plan. The alternative plan would purchase 278 ships between 2011 and 2040. Again, the battle force fleet would peak at 312 ships in 2021, but thereafter it would decline only to a range of 286 to 291 ships between 2030 and 2040—about the same size as today's fleet.

Most of the cuts under the draft 2011 plan and the alternative construction plan come from the Navy's combat ships: surface combatants, submarines, aircraft carriers, and amphibious ships. Under the 2009 shipbuilding plan, the Navy would have purchased 245 combat ships. That number falls by 32 percent (to 166) in the draft 2011 plan and by 16 percent (to 207) in the alternative plan (see Table 3). Thus, by 2038, the draft plan would produce a fleet of 189 combat ships, compared with 239 today or 268 under the 2009 plan. The alternative construction plan would yield a fleet of 222 combat ships.

It is not clear from available information what the Navy believes the draft 2011 plan will cost. If the service assumed an average annual shipbuilding budget of $15 billion over the 30-year period of the plan, the 222 ships purchased under the plan would imply an average cost of $2.0 billion per ship. A $13 billion annual shipbuilding budget would imply an average per-ship cost of $1.8 billion. Both of those figures are much smaller than the $2.5 billion per ship implied by the 2009 plan. In the alternative 2011 construction plan, which envisions that the Navy will receive an extra $85 billion to fund its new class of SSBNs, the service buys 56 additional ships. Under that plan, the $15 billion and $13 billion budget levels would imply average per-ship costs of $1.9 billion and $1.7 billion, respectively.

CBO's preliminary assessment of the draft 2011 plan suggests that it would cost considerably more than $15 billion per year to implement. On the basis of the limited

11. According to later press reports, the Navy has added five ships to the 2011 plan: one attack submarine (in 2015), two littoral combat ships (in 2012 and 2013), and two logistics ships (in 2013 and 2015); see Christopher J. Castelli, "Pentagon Restores Submarine, Seabasing in Budget Endgame," *Inside the Pentagon* (January 7, 2010). CBO's analysis does not include those five extra ships, although the testimony that the Congressional Research Service is delivering today does reflect those changes.

Table 3.

Ship Purchases and Inventory Under Various Navy Shipbuilding Plans

	2009 Plan	Draft 2011 Plan	Alternative 2011 Construction Plan[a]
		Total Purchases over 30 Years	
Combat Ships	245	166	207
Logistics and Support Ships	51	56	71
Total	**296**	**222**	**278**
		Inventory[b]	
In 2025			
Combat Ships	266	234	240
Logistics and Support Ships	54	67	67
Total	**320**	**301**	**307**
In 2038[c]			
Combat Ships	268	189	222
Logistics and Support Ships	54	53	66
Total	**322**	**242**	**288**

Source: Congressional Budget Office based on data from the Navy and www.InsideDefense.com.

a. The "alternative construction plan" included in draft Navy documents resembles the draft 2011 plan but with additional resources provided to fund the replacement of the Navy's ballistic missile submarines; the costs of that replacement could otherwise displace some ships from the construction plan.

b. The Navy currently has 239 combat ships and 48 logistics and support ships, for a total fleet of 287 ships.

c. Because the Navy's long-term shipbuilding plans typically cover 30 years, 2038 is the final year of the 2009 plan. (The 2011 plans run through 2040.)

information available in the press, CBO estimates that carrying out all of the shipbuilding activities in the draft plan would cost an average of about $20 billion a year (in 2010 dollars) between 2011 and 2040. The alternative 2011 construction plan would cost an average of about $23 billion per year. Those estimates may change depending on the details that are in the official 2011 plan when the Navy submits it next month.

One notable feature of the draft plan is that the Navy appears to be budgeting amounts for the littoral combat ship that would greatly exceed the Congressionally mandated cost cap for those ships. The cap, which is adjusted each year for inflation, is currently $480 million per vessel (excluding outfitting costs, postdelivery costs, and costs for the mission modules that LCSs will carry). According to the draft tables available for the 2011 plan, the Navy hopes to buy two LCSs in 2011 for a total of

$1.2 billion, another two in 2012 for $1.2 billion, three in 2013 for $1.8 billion, four in 2014 for $2.6 billion, and four more in 2015 for $2.6 billion (all in then-year dollars). Thus, the total amount budgeted for those 15 LCSs between 2011 and 2015 is $9.4 billion, whereas the adjusted cost cap would permit no more than $7.8 billion.

The Cost of Replacing Ohio Class Ballistic Missile Submarines

The Navy's Ohio class submarines, which carry Trident ballistic missiles, are the sea-based leg of the U.S. strategic triad for delivering nuclear weapons.[12] Those submarines will start to reach the end of their service lives in the late 2020s. Under the draft 2011 plan, replacing the Ohio class SSBNs would consume a significant share of the resources devoted to ship construction over the next 30 years. The Navy's 2009 plan included a requirement for a fleet of 14 SSBNs, but it envisioned buying only 12 of those submarines, two fewer than in the 2007 and 2008 shipbuilding plans. The tables available for the draft 2011 plan suggest that the Navy has reduced its requirement for SSBNs to 12 and that it intends to buy that number of replacements for the Ohio class submarines over the next three decades.

The Navy's Estimates

The design, cost, and capabilities of that replacement class—currently called the SSBN(X)—are among the most significant uncertainties in the Navy's and CBO's analyses. The Navy's 2007 and 2008 shipbuilding plans assumed that the first SSBN(X) would cost $4.3 billion and that subsequent ships in the class would cost about $3.3 billion each, implying an average cost of about $3.4 billion per submarine. The 2009 plan explicitly excluded the costs of the SSBN(X), although it included 12 of the submarines in its projection of future inventories.

Press reports now indicate that the Navy expects a class of 12 SSBN(X)s to cost a total of about $80 billion, an amount that the Navy said it determined by inflating the cost of the original Ohio class to today's dollars. That total implies an average cost of about $6.7 billion per submarine.[13] The first SSBN(X) would be authorized in 2019 (although advance procurement money would be needed in 2017 and 2018 for long-lead items such as the ship's nuclear reactor). The second submarine would be purchased in 2022, followed by one per year from 2024 to 2033.

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12. The other two legs are land-based intercontinental missiles and manned strategic bombers.

13. Christopher J. Castelli, "Navy Confronts $80 Billion Cost of New Ballistic Missile Submarines (Updated)," *Inside the Pentagon* (December 3, 2009). Later in that article, the average cost of a new SSBN is said to be $6 billion to $7 billion, implying a total cost of $72 billion to $84 billion for the entire class.

CBO's Estimates

Many Navy and industry officials involved with submarine warfare or construction expect that an SSBN(X) would be substantially smaller than an Ohio class submarine. However, that does not necessarily mean it would be cheaper to build, even with the effects of inflation removed.

Since 1991, when the last Ohio class submarine was authorized, the submarine industry has improved its design and construction processes. Both General Dynamics's Electric Boat shipyard and Northrup Grumman's Newport News shipyard use more-modern construction techniques and have become more efficient. Those changes suggest that using the Ohio class as an analogy to estimate the future costs of the SSBN(X) could overstate costs.

At the same time, however, the factors described above that have caused average ship costs to grow over time also apply to submarines. Growth in labor and materials costs in the submarine construction industry has outstripped general inflation. In addition, the capabilities of the Navy's submarines have improved over the years, making them more expensive to produce. Finally, Ohio class submarines were built at a time when the Navy was constructing many more warships (including aircraft carriers at Newport News and submarines at both shipyards) than it is today, which suggests that those earlier submarines benefitted from having fixed overhead costs spread over more ships.

The growth in submarine costs over time can be seen by comparing the cost per thousand tons of the lead ship of U.S. submarine classes produced in the past 40 years (see Figure 3). In the 1970s, the Navy built the first Los Angeles class attack submarine and the first Ohio class ballistic missile submarine for about $350 million to $400 million per thousand tons of Condition A weight (a term analogous to lightship displacement on surface ships, which is the weight of the ship excluding fuel, ammunition, crew, and stores). By the late 1980s and 1990s, the cost of the lead ships of the Seawolf and Virginia classes of attack submarines had more than doubled to $825 million to $850 million per thousand tons.[14]

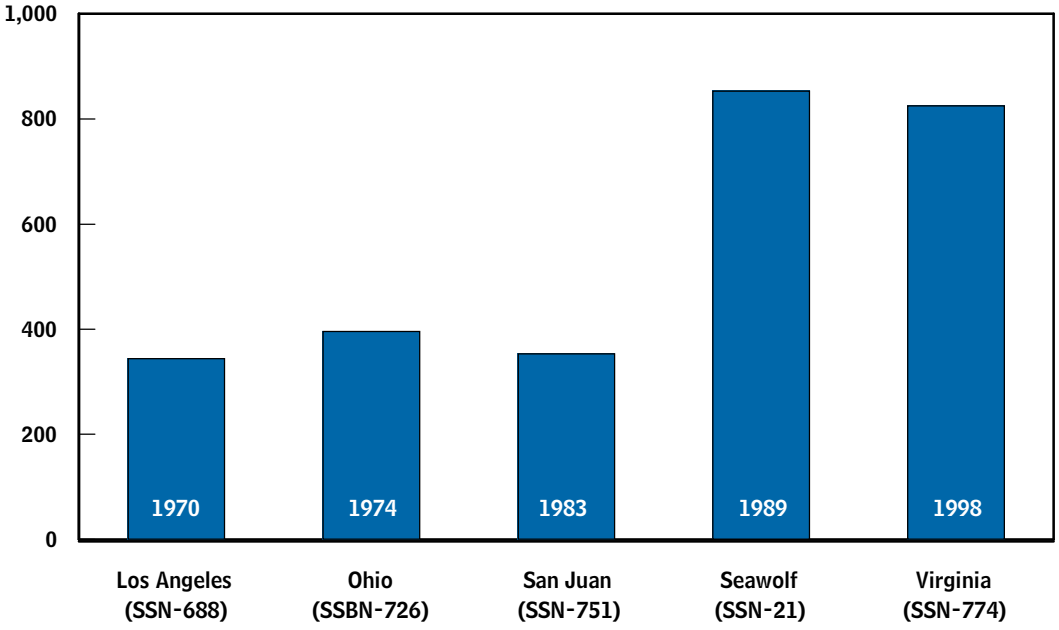
In most of its recent naval analyses, CBO has assumed that the SSBN(X) would carry 16 missile tubes instead of the 24 on existing submarines and would displace around 15,000 tons submerged—making it roughly twice as big as a Virginia class attack submarine but nearly 4,000 tons smaller than an Ohio class SSBN. On the basis of that assumed size—as well as the amount the Navy is currently paying for a Virginia class submarine and historical cost growth in shipbuilding programs—CBO estimates that 12 SSBN(X)s would cost an average of $7.0 billion each (in 2010 dollars). The lead ship of the class could cost about $11 billion (including some nonrecurring items) when ordered in 2019. In all, CBO expects a class of 12 SSBN(X)s to cost a total of about $85 billion.

14. At around 9,100 tons submerged, a Seawolf class submarine is about 20 percent larger than a Virginia class submarine but only half the size of an Ohio class SSBN.

Figure 3.

Cost per Thousand Tons for the Lead Ship of Various Classes of Submarines

(Millions of 2010 dollars)



Source: Congressional Budget Office based on data from the Navy.

The figures that the Navy is using now for the SSBN(X), as reported in the press, appear to align more closely with CBO's estimates of the past three years than with the estimate that the Navy used in formulating its 2007 and 2008 shipbuilding plans. CBO's estimate of $7.0 billion per submarine is slightly larger than the reported Navy figure of about $6.7 billion, which is twice the $3.4 billion average cost that the Navy assumed for the SSBN(X) in its 2007 and 2008 shipbuilding plans.

Ballistic missile submarines are more capable of surviving attacks than the other legs of the U.S. strategic triad, and they carry about half of the nation's deployed nuclear warheads. Given that role, policymakers may regard replacing the Ohio class when it retires as the most critical part of the Navy's shipbuilding plan. If those SSBNs were going to be replaced no matter what happened, and if the Navy received enough resources to pay for them above and beyond what it might otherwise expect to allocate to shipbuilding, it could use the additional funding to buy more surface ships and attack submarines. That is the presumed motivation behind the alternative construction plan that accompanied the draft 2011 plan. CBO's estimate of the difference in costs between the draft 2011 plan and the alternative construction plan is $3 billion per year, or a total of about $90 billion (compared with the estimated $85 billion cost of 12 SSBN(X)s). Under the alternative plan, that extra $90 billion would purchase

56 additional ships: 19 large surface combatants, 15 littoral combat ships, 4 attack submarines, 3 amphibious ships, and 15 logistics and support ships.

Surface Combatants Required to Support Ballistic Missile Defense

The Subcommittee asked CBO to evaluate the number of Aegis-capable surface combatants needed to perform the ballistic missile defense (BMD) mission in Europe. The answer could range from 3 to 15 depending on the rotation method the Navy used to provide ships for BMD patrols, which CBO assumed would require continuous coverage of the patrol areas.[15] The Missile Defense Agency (MDA) is also concerned with a broader mission of providing missile defense to parts of the Middle East as well as to Europe, which would require additional patrol areas needing continuous presence by BMD-capable ships. CBO estimated the number of ships required for missile defense—focusing on Europe first—using three possible rotation methods:

- **Traditional Rotation (5:1)**—Under the Navy's current deployment cycle for surface combatants, five ships (based in Norfolk, Va.) are necessary to keep one ship forward deployed in the European theater at all times. That cycle typically keeps ships deployed for six months at a time. After that, they spend 18 to 21months in their home port while their crews rest and train and the ship undergoes maintenance in preparation for the next six-month deployment (although during much of that time, the ship remains in a near-ready state to deploy quickly if necessary).[16] Thus, at any point, roughly three of the five ships in the rotation will be in the early, middle, or late stage of their time in their home port, a fourth ship will be deploying to or from the theater of operations, and the fifth ship will be on-station in the theater.

- **Rotating Crews (3:1)**—In this method, which is similar to what the Navy is planning for littoral combat ships, three or four crews take turns operating three ships, one of which is forward deployed at any given time. Depending on the rotation model, a ship remains overseas longer than six months, and replacement crews are flown to its location in the theater to take over running it, while two other ships remain in their home port in the continental United States for training and maintenance. That rotation method lets ships spend less overall time in transit to and from a theater and more time on-station. (In an experiment called Sea Swap

15. In fact, the requirement for continuous coverage has not yet been established. How much coverage is necessary and how frequently it needs to be in place have not been determined by the Department of Defense.

16. Over the next few years, the Navy may keep BMD-capable ships in their home ports for a much shorter period until more of those ships are available. The Navy is planning to convert most of its 84 Aegis cruisers and destroyers to perform ballistic missile defense, but as of 2010, it has converted or funded only 27 ships. See Ronald O'Rourke, *Sea-Based Ballistic Missile Defense—Background and Issues for Congress* (Congressional Research Service, December 22, 2009).

conducted from 2002 to 2006, the Navy successfully rotated crews to individual destroyers while the ships were deployed overseas.)[17]

- **Home Port in Theater (2:1 or 1:1)**—The Navy could permanently base BMD-capable ships in Europe to provide an immediate response to a crisis or even full-time coverage of BMD patrol areas. The Navy counts ships that are based abroad as providing full-time overseas presence. If the Navy needed to ensure that one ship was always at sea providing ballistic missile defense, then a two-ship rotation might be necessary to compensate for whatever time the first ship spent in its European home port for maintenance or other activities.

MDA has reported that sometime in the near term—the next five to seven years—ships may be stationed at three locations in European waters to provide sea-based ballistic missile defense in that theater against Iranian missile threats.[18] Under the Navy's traditional deployment cycle for surface combatants, a rotation of 15 ships would be needed to provide missile defense in Europe from three stations (see Table 4).

For the broader and more demanding mission, MDA expects to need up to eight sea-based BMD stations in Europe and the Persian Gulf in the near term. For the longer term—10 years and beyond—MDA suggests that with improvements in BMD-related missiles, radars, and sensors, the number of stations at sea could be reduced to five. Under the Navy's traditional deployment cycle, eight stations could require a rotation of 42 ships, whereas five stations could require 26 ships.[19]

The Navy could reduce the number of ships needed to provide full-time BMD presence in Europe by employing alternative crewing schemes or basing ships in the theater. For example, if the Navy used rotating crews along the lines of its Sea Swap experiments or its plan for LCSs, it might need only three ships to keep one operating full time in a designated BMD patrol area. In that case, only 24 ships would be necessary to support eight BMD stations in the near term, or 15 ships to support five

17. For a more detailed discussion of Sea Swap and the benefits of rotating crews to surface combatants to increase the amount of time they can spend forward deployed, see Congressional Budget Office, *Crew Rotation in the Navy: The Long-Term Effect on Forward Presence* (October 2007).

18. CBO used a similar framework in its analysis of ballistic missile defense in Europe. Three ships equipped with Standard Missile-3 Block IIA interceptors (which are currently planned to enter the fleet in about 2018) would provide nearly complete coverage of Europe against Iranian missiles. See Congressional Budget Office, *Options for Deploying Missile Defenses in Europe* (February 2009), pp. 17–22.

19. Because the Persian Gulf takes longer to reach from the United States than Europe does, the Persian Gulf would require a ship-rotation ratio of 6:1 if the ships deployed from Norfolk, Va. (or about 7:1 if they deployed from the U.S. Pacific Fleet). Thus, for eight stations, six ships in the European theater at a ratio of 5:1, plus two ships in the Persian Gulf at a ratio of 6:1, equals 42 ships. For five stations, four ships in the European theater at a ratio of 5:1, plus one in the Persian Gulf at a ratio of 6:1, equals 26 ships.

Table 4.

Number of Ships Needed to Maintain Continuous Presence for Sea-Based Ballistic Missile Defense

	Number of Ballistic Missile Stations		
	Three (Defending only Europe in the near term)	Five (Defending Europe and the Middle East over the long term)	Eight (Defending Europe and the Middle East in the near term)
Traditional Rotation	15	26 [a]	42 [a]
Rotating Crews	9	15	24
Home Port in Theater	3 to 6	5 to 10	8 to 16

Source: Congressional Budget Office.

a. With five stations, one would be in the Persian Gulf, which would require a rotation ratio of 6:1 if the ships deployed from Norfolk, Va. With eight stations, two would be in the Persian Gulf.

stations over the long term. If the BMD requirement was limited to three stations around Europe, then just nine ships with rotating crews would be needed.

The BMD mission may be better suited to the use of rotating crews than traditional missions performed by surface combatants are. A BMD-capable surface combatant dedicated to the single mission of providing missile defense patrols would be analogous to the Navy's SSBNs, which have the single mission of providing deterrent patrols at sea with nuclear missiles. Focusing on a single mission makes it easier for the multiple crews of a single ship to maintain their proficiency when not on deployment. The Navy uses a dual-crew system for SSBNs, in which two crews take turns taking a submarine to sea to perform its mission. That system allows strategic submarines to spend a majority of their service life at sea, compared with less than 30 percent for single-crewed attack submarines.

The Navy, however, does not currently envision dedicating ships to the single mission of missile defense. Instead, it plans to send BMD-capable ships on regular deployments to perform the full range of missions required of surface combatants, although some of the ships would operate in or near the BMD stations, available to perform that mission in the event of heightened tensions. Under such a system, using rotating crews on BMD-capable ships could prove far more challenging because the crews would need to maintain a high level of proficiency in many types of missions.

Alternatively, if the Navy was able to base BMD-capable ships permanently in Europe or the Persian Gulf—as it does now in Japan to counter the threat of North Korean missiles—it might need as few as three to eight ships (one for each station). That estimate assumes that the Navy counts each of those ships as providing full-time presence

on-station, in the same way that it considers ships based in Japan to be providing full-time presence even when they are in port undergoing routine maintenance. But if the Navy needed to guarantee that one ship per station was at sea at all times, it would require a second ship for each of the three to eight stations, doubling the requirement. Those additional ships could also be based at home ports in the European theater.